

SUBSTITUTE FORM PTO-1390 U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE		ATTORNEY'S DOCKET NUMBER 08291-673001
<b>TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371</b>		U.S. APPLICATION NO. (If Known, see 37 CFR 1.5) <b>09/720942</b>

INTERNATIONAL APPLICATION NO PCT/GB99/01979	INTERNATIONAL FILING DATE 23 June 1999	PRIORITY DATE CLAIMED 2 July 1998
--	---	--------------------------------------

TITLE OF INVENTION  
TREATMENT OF AIRBORNE MICROORGANISMS

APPLICANT(S) FOR DO/EO/US  
Rodney Thomas FOX, Neale HARRISON, John Farrell HUGHES, Duncan Roger HARPER, Lindsey Faye WHITMORE, Karen Louis JERRIM and Jennifer Jane KNAPP

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

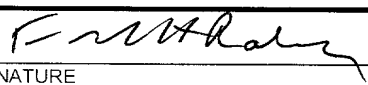
1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to promptly begin national examination procedures (35 U.S.C. 371(f)).
4. ☐ The US has been elected by the expiration of 19 months from the priority date (PCT Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
  - a. ☐ is attached hereto (required only if not communicated by the International Bureau).
  - b. ☒ has been communicated by the International Bureau.
  - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☐ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
  - a. ☐ are attached hereto (required only if not communicated by the International Bureau).
  - b. ☐ have been communicated by the International Bureau.
  - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
  - d. ☒ have not been made and will not be made.
8. ☐ An English language translation of amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)) (UNSIGNED)
10. ☐ An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5))

Items 11 to 16 below concern other documents or information included:

11. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A FIRST preliminary amendment  
☐ A SECOND or SUBSEQUENT preliminary amendment.
14. ☐ A substitute specification.
15. ☐ A change of power of attorney and/or address letter.
16. ☒ Other items or information:

- ☒ PCT Notification of Transmittal of the International Preliminary Examination Report dated 10 April 2000.
- ☐
- ☐
- ☐
- ☐

CERTIFICATE OF MAILING BY EXPRESS MAIL		Express Mail Label No <b>EF3538152942</b>
I hereby certify under 37 CFR §1.10 that this correspondence is being deposited with the United States Postal Service as Express Mail Post Office to Addressee with sufficient postage on the date indicated below, and is addressed to the Commissioner for Patents Washington D.C. 20231		
Date of Deposit <b>January 2, 2001</b>	Signature <i>[Signature]</i>	Typed Name of Person Signing <b>F. J. [Name]</b>

U.S. APPLICATION NO. (IF KNOWN) <div style="font-size: 1.5em; font-weight: bold;">09/720942</div>		INTERNATIONAL APPLICATION NO PCT/GB99/01979		ATTORNEY'S DOCKET NUMBER 08291-673001	
17. <input checked="" type="checkbox"/> The following fees are submitted:  <b>Basic National Fee ( 37 CFR 1.492(a)(1)-(5) ):</b>  Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO ..... <b>\$1000</b>  International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO ..... <b>\$860</b>  International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO..... <b>\$710</b>  International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4) ..... <b>\$690</b>  International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4)..... <b>\$100</b>  <div style="text-align: right;"><b>ENTER APPROPRIATE BASIC FEE AMOUNT =</b></div>				<b>CALCULATIONS</b> PTO USE ONLY	
				\$860.00	
Surcharge of <b>\$130</b> for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(e)).				\$0.00	
Claims	Number Filed	Number Extra	Rate		
Total Claims	15 - 20 =	0	x <b>\$18</b>	\$0.00	
Independent Claims	1 - 3 =	0	x <b>\$80</b>	\$0.00	
MULTIPLE DEPENDENT CLAIMS(S) (if applicable)			+ <b>\$270</b>	\$0.00	
<b>TOTAL OF ABOVE CALCULATIONS =</b>				\$860.00	
<input type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27 The fees indicated above are reduced by 1/2.				\$0.00	
<b>SUBTOTAL =</b>				\$860.00	
Processing fee of <b>\$130</b> for furnishing the English Translation later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(f))				\$0.00	
<b>TOTAL NATIONAL FEE =</b>				\$860.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). <b>\$40.00</b> per property +				\$0.00	
<b>TOTAL FEES ENCLOSED =</b>				\$860.00	
				<b>Amount to be refunded:</b>	\$
				<b>Charged:</b>	\$
a. <input checked="" type="checkbox"/> A check in the amount of \$860.00 to cover the above fees is enclosed. b. <input type="checkbox"/> Please charge my Deposit Account No. 06-1050 in the amount of \$0 00 to cover the above fees. A duplicate copy of this sheet is enclosed. c. <input checked="" type="checkbox"/> The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 06-1050. A duplicate copy of this sheet is enclosed.  <b>NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive          (37 CFR 1.137(a) or (b) must be filed and granted to restore the application to pending status.</b>  SEND ALL CORRESPONDENCE TO					
Frederick H. Rabin FISH & RICHARDSON P.C. 45 Rockefeller Plaza, Suite 2800 New York, NY 10111 (212) 765-5070 phone (212) 258-2291 facsimile Date: <u>2 Jan 01</u>			 SIGNATURE  Frederick H. Rabin NAME  24,488 REGISTRATION NUMBER		

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant : Rodney Thomas FOX et al.  
Int'l Appln. No.: PCT/GB99/01979  
Int'l Filing Date: 23 June 1999  
Title : TREATMENT OF AIRBORNE MICROORGANISMS

**Box: PCT**  
Commissioner for Patents  
Washington, D.C. 20231

PRELIMINARY AMENDMENT UNDER 37 C.F.R. § 1.115

Prior to examining this application, kindly enter the following amendments:

In the Specification:

On page 1, line 2: insert, as a heading:

--Background of the Invention--.

On page 1, line 15: change "or." to --or--.

On page 1, line 20: change "sufficient." to --sufficient--.

On page 2, line 13: change "human" to --humans--.

On page 3, after line 6: insert, as a heading:

--Summary of the Invention--.

CERTIFICATE OF MAILING BY EXPRESS MAIL

Express Mail Label No EF353815249US

I hereby certify under 37 CFR §1.10 that this correspondence is being deposited with the United States Postal Service as Express Mail Post Office to Addressee with sufficient postage on the date indicated below and is addressed to the Commissioner for Patents, Washington, D C 20231

Date of Deposit January 2, 2001

Francis Robles  
Signature

Francis Robles  
Typed or Printed Name of Person Signing Certificate

On page 3, after line 17: insert

--Brief Description of the Drawings

Figure 1 is a diagrammatic cross section through an aerosol spraying apparatus in accordance with the invention;

Figure 2 is a diagrammatic cross section through the valve assembly of the apparatus of Figure 1;

Figure 3 is a cross section through the actuator insert of the assembly shown in Figure 2;

Figure 4 shows the configuration of the bore of the spraying head shown in Figure 3 when viewed in the direction A; and

Figure 5 shows the configuration of the swirl chamber of the spraying head shown in Figure 3 when viewed in the direction B.

Detailed Disclosure--.

On page 3, line 19: change "sanitizing" to --sanitising--.

On page 5, line 29: change "is" to --are--.

On page 10, line 29: change "accompanying drawings, in which:-" to --drawings.--.

On page 10, line 30, through page 11, line 11: delete "Figure 1 is a diagrammatic cross section through an aerosol spraying apparatus in accordance with the invention; Figure 2 is a diagrammatic cross section through the valve assembly of the apparatus of Figure 1; Figure 3 is a cross section through the actuator insert of the assembly shown in Figure 2; Figure 4 shows the configuration of the bore of the spraying head shown in Figure 3 when viewed in the direction A; and Figure 5 shows the configuration of the swirl chamber of the spraying head shown in Figure 3 when viewed in the direction B."

On page 11, line 13: change "It." to --It--.

On page 13, line 10: change "2" to --two--.

On page 13, line 31: change "L/a" to --L/a--.

On page 14, line 6: change "L/a" to --L/a--.

On page 14, line 29: change "4" to --four--.

In the Claims:

The claims in this application are as follows:

**--1. (Amended) A method of disinfecting or sanitising a space occupied by airborne microorganisms and/or viruses, which method comprises directing into the space liquid droplets from a spray device containing a disinfecting or sanitising composition, a unipolar charge being imparted to the liquid droplets by double layer charging during the spraying of the liquid droplets from the aerosol spray device, the unipolar charge being at a level such that said droplets have a charge to mass ratio of at least  $\pm 1 \times 10^{-4}$  C/kg.**

**2. A method as claimed in claim 1 wherein the spray device is an aerosol spray device.**

**3. (Amended) A method as claimed in claim 2 wherein the disinfecting or sanitising composition is an emulsion.**

**4. (Amended) A method as claimed in claim 3 wherein the liquid droplets have a diameter in the range of from 5 to 100 micrometres.**

**5. (Amended) A method as claimed in claim 4 wherein the unipolar charge is imparted to the liquid droplets solely by the interaction between the liquid and the spray device, without any charge being imparted thereto from an internal or external charge inducing device.**

**6. (Amended) A method as claimed in claim 5 wherein the required droplet charge to mass ratio is imparted to the droplets as a result of the use of an aerosol spray device with at least one of the features of:**

- (a) the material of the actuator,**
- (b) the size and shape of the orifice of the actuator,**
- (c) the diameter of the dip tube,**
- (d) the characteristics of the valve, and**
- (e) the formulation of the disinfecting or sanitising composition contained within the aerosol spray device**

**being chosen in order to achieve said droplet charge to mass ratio by double layer charging imparting the unipolar charge to the droplets during the actual spraying of the liquid droplets from the orifice of the aerosol spray device.**

**7. (Amended) A method as claimed in claim 6 wherein the disinfecting or sanitising composition comprises: an oil phase; and aqueous phase; a surfactant; an anti-bacterial agent, a fungicide or an anti-viral agent; and a propellant.**

**8. (Amended) A method as claimed in claim 7 in which the composition comprises, as an anti-bacterial or anti-viral agent, an essential oil selected from the group consisting of thyme, lemon grass, lemon, orange, grapefruit, yeast, oregano, anise, clove, cinnamaldehyde, cinnamon, carvacrol, rose, lavender, citronella, eucalyptus, peppermint, camphor, sandalwood, juniper berry, Siberian pine needle, pine sylvester, tea tree, litsea, rosewood, patchouli, vetyver, cedarwood and mixtures thereof.**

**9. (Amended) A method as claimed in claim 7 which comprises a quaternary ammonium compound as an anti-bacterial agent.**

**10. (Amended) A method as claimed in claim 7 wherein the oil phase includes a C<sub>9</sub>-C<sub>12</sub> hydrocarbon.**

**11. A method as claimed in claim 10 wherein the C<sub>9</sub>-C<sub>12</sub> hydrocarbon is present in the composition in an amount of from 2 to 10% w/w.**

**12. (Amended) A method as claimed in claim 7 wherein the surfactant is glyceryl oleate or a polyglycerol oleate.**

**13. (Amended) A method as claimed in claim 12 wherein the surfactant is present in the composition in an amount of from 0.1 to 1.0% w/w.**

**14. (Amended) A method as claimed in claim 7 wherein the propellant is liquified petroleum gas.**

**15. A method as claimed in claim 14 wherein the propellant is present in the composition in an amount of from 20 to 50% w/w.--**

Attached, as Appendix A, is a copy of the amended claims marked to show changes.

In the Abstract:

Attached, as page 23 of the application, is an Abstract of the Disclosure.

Applicant : Rodney Thomas FOX et al.  
Serial No. : PCT/GB99/01979  
Filed : 23 June 1999  
Page : 6

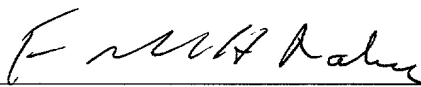
Attorney's Docket No.: 08291-673001

REMARKS

The foregoing Amendment inserts section headings in the specification, corrects some typographical errors, amends the claims to conform to American practice and adds an Abstract complying with 37 C.F.R. § 1.72(b).

Respectfully submitted,

Date: 2 Jan. 2001

  
\_\_\_\_\_  
Frederick H. Rabin  
Reg. No. 24,488

Fish & Richardson P.C.  
45 Rockefeller Plaza, Suite 2800  
New York, NY 10111  
Telephone: (212) 765-5070  
Facsimile: (212) 258-2291

30036786 doc



### Appendix A

1. (Amended) A method of disinfecting or sanitising a space occupied by airborne microorganisms and/or viruses, which method comprises directing into the space liquid droplets from a spray device containing a disinfecting or sanitising composition, a unipolar charge being imparted to the [said] liquid droplets by double layer charging during the spraying of the liquid droplets from the aerosol spray device, the unipolar charge being at a level such that [the] said droplets have a charge to mass ratio of at least  $\pm 1 \times 10^{-4}$  C/kg.

3. (Amended) A method as claimed in [claim 1 or] claim 2 wherein the disinfecting or sanitising composition is an emulsion.

4. (Amended) A method as claimed in [any one of the preceding claims] claim 3 wherein the liquid droplets have a diameter in the range of from 5 to 100 micrometres.

5. (Amended) A method as claimed in [any one of the preceding claims] claim 4 wherein the unipolar charge is imparted to the liquid droplets solely by the interaction between the liquid and the spray device, without any charge being imparted thereto from an internal or external charge inducing device.

6. (Amended) A method as claimed in claim 5 wherein the required droplet charge to mass ratio [of at least  $\pm 1 \times 10^{-4}$  C/kg] is imparted to the droplets as a result of the use of an aerosol spray device with at least one of the features of: (a) the material of the actuator, (b) the size and shape of the orifice of the actuator, (c) the diameter of the dip tube, (d) the characteristics of the valve, and (e) the formulation of the disinfecting or sanitising composition contained within the aerosol spray device being chosen in order to achieve [the] said droplet charge to mass ratio by double layer charging imparting the

unipolar charge to the droplets during the actual spraying of the liquid droplets from the orifice of the aerosol spray device.

7. (Amended) A method as claimed in [any one of the preceding claims] claim 6 wherein the disinfecting or sanitising composition comprises: an oil phase[,]; and aqueous phase[,]; a surfactant[,]; an anti-bacterial agent, a fungicide or an anti-viral agent[,]; and a propellant.

8. (Amended) A method as claimed in claim 7 [wherein the] in which the composition comprises, as an anti-bacterial or anti-viral agent, [is] an essential oil selected from the group consisting of thyme, lemon grass, lemon, orange, grapefruit, yeast, oregano, anise, clove, cinnamaldehyde, cinnamon, carvacrol, rose, lavender, citronella, eucalyptus, peppermint, camphor, sandalwood, juniper berry, Siberian pine needle, pine sylvester, tea tree, litsea, rosewood, patchouli, vetyver, cedarwood and mixtures thereof.

9. (Amended) A method as claimed in claim 7 [wherein the anti-bacterial agent is] which comprises a quaternary ammonium compound as an anti-bacterial agent.

10. (Amended) A method [according to any one of claims] as claimed in claim 7 [to 9] wherein the oil phase includes a C<sub>9</sub>-C<sub>12</sub> hydrocarbon.

12. (Amended) A method as claimed in [any one of claims] claim 7 [to 11] wherein the surfactant is glyceryl oleate or a polyglycerol oleate.

13. (Amended) A method as claimed in [any one of claims 7 to] claim 12 wherein the surfactant is present in the composition in an amount of from 0.1 to 1.0% w/w.

14. (Amended) A method as claimed in [any one of claims] claim 7 [to 13] wherein the propellant is liquified petroleum gas.

## Abstract

A method of disinfecting or sanitising a space occupied by airborne microorganisms and/or viruses, which method comprises directing into the space liquid droplets from a spray device containing a disinfecting or sanitising compositions, a unipolar charge being imparted to the said liquid droplets by double layer charging during the spraying of the liquid droplets from the aerosol spray device, the unipolar charge being at a level such that the said droplets have a charge to mass ratio of at least  $\pm 1 \times 10^{-4}$  C/kg.

30036787.doc

3 ppts

TREATMENT OF AIRBORNE MICROORGANISMS

The present invention relates to the treatment of airborne microorganisms and viruses.

5           Disinfectants and sanitising compositions based on essential oils are known, for example from US Patent No. 5403587. This Patent is concerned with antimicrobial compositions for use in sanitising, disinfecting and/or cleaning hard surfaces such as  
10       countertops, tiles, porcelain products such as sinks and toilets, floors, windows, eating utensils, glassware, dishes and dental and surgical instruments.

The compositions comprise:-

- 15           a)    an anti-microbially effective amount of an essential oil capable of being dissolved or dispersed in a water carrier and exhibiting antimicrobial properties when incorporated in a water carrier;
- 20           b)    a solubilising or dispersing amount of a solubilising or dispersing agent sufficient to form an aqueous solution or dispersion of the essential oil in a water carrier; and
- c)    sufficient water to make 100 wt percentage.

25       Essential oils stated to be of use in the invention as disclosed in US Patent No. 5403587 include oils obtained from thyme, lemon grass, lemons, oranges, anise, clove, roses, lavender, citronella, eucalyptus, peppermint, camphor, sandalwood and cedar.

30       The compositions of US Patent No. 5403587 are stated to be capable of being formulated with conventional propellants for dispensing as aerosols

from conventional pressurised containers. Propellants which can be used include isobutane, n-butane, propane, dimethyl ether and blends thereof, as well as chlorofluorohydrocarbons, fluorohydrocarbons and mixtures thereof.

It is known to be difficult to treat airborne microorganisms. In general, it is not easy to eliminate them completely from a particular space such as that defined by a room. Furthermore, any aggressive form of treatment, such as the use of a spray of a composition which is toxic to the microorganisms is likely to be a health hazard to human or animals within the space being treated.

Bacteria, viruses and fungal spores can be considered to be particulate in nature when they are airborne, particularly since they are often attached to or associated with dust particles. In the case of the use of an aerosol spray device, a liquid composition containing a disinfectant is sprayed in the form of tiny droplets in the space which is to be disinfected. However, a low collision rate between the liquid droplets and the microorganisms in the air results in an ineffective killing of the microorganisms. The practical consequence of such inefficiency is that the disinfectant composition would need to be used in a high amount, thereby incurring a health risk. There are other possible side effects including, in the use of a perfumed composition, a resultant strong perfume smell because of the need to use a considerable amount of disinfectant composition and/or a limited fragrance

choice.

An aerosol spray type device would be of improved efficacy if the aerosol spray droplets had a higher collision rate with the microorganisms. We have now  
5 developed an improved method of disinfecting or sanitising a space.

According to the present invention there is provided a method of disinfecting or sanitising a space occupied by airborne microorganisms and/or  
10 viruses, which method comprises directing into the space liquid droplets from a spray device containing a disinfecting or sanitising composition, a unipolar charge being imparted to the said liquid droplets by double layer charging during the spraying of the  
15 liquid droplets from the spray device, the unipolar charge being at a level such that the said droplets have a charge to mass ratio of at least  $\pm 1 \times 10^{-4}$  C/kg.

The disinfecting or sanitizing composition which  
20 is sprayed in the method of the present invention contains at least one anti-microbial agent. Examples of such anti-microbial agents are essential oils such as thyme, lemon grass, lemon, orange, grapefruit, yeast, oregano, anise, clove, cinnamaldehyde,  
25 cinnamon, carvacrol, rose, lavender, citronella, eucalyptus, peppermint, camphor, sandalwood, Siberian pine needle, pine sylvester, tea tree, juniper berry, litsea, rosewood, patchouli, vetyver, cedarwood and mixtures thereof. Other anti-microbial agents which  
30 may be used in the present invention include bactericides, for example quarternary ammonium

compounds such as alkyl dimethyl benzyl ammonium  
saccharinate and benzalkonium chloride, or fungicides  
such as clotrimazole, miconazole nitrate, organotin  
compounds, organic acids, halogenated phenols,  
5 quaternary ammonium compounds, 8-hydroxy quinoline,  
diamidines, organic mercury derivatives and the  
parabens.

It is preferred that the unipolar charge which is  
imparted to the liquid droplets is generated solely by  
10 the interaction between the liquid within the spray  
device and the spray device itself as the liquid is  
sprayed therefrom. In particular, it is preferred  
that the manner in which a unipolar charge is imparted  
to the liquid droplets does not rely even partly upon  
15 the connection of the device to any external charge  
inducing device, such as a source of relatively high  
voltage or any internal charge inducing device, such  
as a battery. With such an arrangement, the spray  
device is entirely self-contained making it suitable  
20 for use both in industrial, institutional and domestic  
environments.

Preferably, the spray device is a domestic  
pressure-spraying device devoid of any electrical  
circuitry but which is capable of being hand held.  
25 Typically such a device has a capacity in the range of  
from 10ml to 2000ml and can be actuated by hand, or by  
an automatic actuating mechanism. A particularly  
preferred domestic device is a hand-held aerosol can.

Preferably, therefore the droplet charge to mass  
30 ratio of at least  $\pm 1 \times 10^{-4}$  C/kg is imparted to the  
droplets as a result of the use of an aerosol spray

device with at least one of the features of the material of the actuator, the size and shape of the orifice of the actuator, the diameter of the dip tube, the characteristics of the valve and the formulation of the disinfecting or sanitising composition contained within the aerosol spray device being chosen in order to achieve the said droplet charge to mass ratio by double layer charging imparting the unipolar charge to the droplets during the actual spraying of the liquid droplets from the orifice of the aerosol spray device.

As a result of the method of the present invention, airborne microorganisms and/or viruses can be eliminated with considerable efficiency as compared to known spraying methods. In particular, much less disinfectant or sanitising agent is required than has previously been the case.

This result is achieved because of the unipolar charge imparted to the liquid droplets of the aerosol spray. This charge has two effects. The individual droplets are attracted to the microorganisms and/or viruses, including microorganisms attached to dust particles. Since all of the droplets carry the same polarity charge, they are repelled one from another. Accordingly, there is little or no coalescence of the droplets and, in contrast, they tend to spread out to a great extent as compared to uncharged droplets. In addition, if the repulsive forces from the charge within the droplets is greater than the surface tension force of the droplets, the charged droplets are caused to fragment into a plurality of smaller



charged droplets (exceeding the Rayleigh limit). This process continues until either the two opposing forces are equalised or the droplet has fully evaporated.

Airborne microorganisms, including those attached  
5 to dust particles, are normally electrically isolated from their surroundings and will typically be at a potential which is the same as that of their surroundings. In this situation, an isolated micro-  
10 organism within a cloud of electrically charged liquid droplets thus is likely to cause a distortion in the configuration of the electrical field generated by the droplets so that the attraction of the droplets onto the microorganism will be improved. In effect, the  
15 microorganism is targeted by a liquid droplet. This improvement in the interaction between the charged droplets and the microorganisms is due to the combined effect of the additional diffusion forces generated within the charged cloud of droplets by the electric field, leading to a modification of the trajectory of  
20 each droplet so that it is directed towards a microorganism.

In general, the liquid composition which is sprayed into the air using the aerosol spray device is preferably a water and hydrocarbon mixture, or  
25 emulsion, or a liquid which is converted into an emulsion by shaking the spraying device before use, or during the spraying process.

Whilst all liquid aerosols are known to carry a net negative or positive charge as a result of double  
30 layer charging, or the fragmentation of liquid droplets, the charge imparted to droplets of liquid

sprayed from standard devices is only of the order of  
+/-  $1 \times 10^{-8}$  to  $10^{-5}$  C/kg.

The invention relies on combining various  
characteristics of the design of an aerosol spray  
5 device so as to increase the charging of the liquid as  
it is sprayed from the aerosol spray device.

A typical aerosol spray device comprises:

1. An aerosol can containing the composition to  
be sprayed from the device and a liquid or  
10 gaseous propellant;
2. A dip tube extending into the can, the upper  
end of the dip tube being connected to a  
valve;
3. An actuator situated above the valve which  
15 is capable of being depressed in order to  
operate the valve; and
4. An insert provided in the actuator  
comprising an orifice from which the  
composition is sprayed.

20 A preferred aerosol spray device for use in the  
present invention is described in WO 97/12227.

It is possible to impart higher charges to the  
liquid droplets by choosing aspects of the aerosol  
device including the material, shape and dimensions of  
25 the actuator, the actuator insert, the valve and the  
dip tube and the characteristics of the liquid which  
is to be sprayed, so that the required level of charge  
is generated as the liquid is dispersed as droplets.

A number of characteristics of the aerosol system  
30 increase double layer charging and charge exchange  
between the liquid formulation and the surfaces of the

aerosol system. Such increase are brought about by factors which may increase the turbulence of the flow through the system, and increase the frequency and velocity of contact between the liquid and the internal surfaces of the container and valve and actuator system.

By way of example, characteristics of the actuator can be optimised to increase the charge levels on the liquid sprayed from the container. A small orifice in the actuator insert, of a size of 0.45mm or less, increases the charge levels of the liquid sprayed through the actuator. The choice of material for the actuator can also increase the charge levels on the liquid sprayed from the device with material such as nylon, polyester, acetal, PVC and polypropylene tending to increase the charge levels. The geometry of the orifice in the insert can be optimised to increase the charge levels on the liquid as it is sprayed through the actuator. Inserts which promote the mechanical break-up of the liquid give better charging.

The actuator insert of the spray device may be formed from a conducting, insulating semi-conducting or static-dissipative material.

The characteristics of the dip tube can be optimised to increase levels in the liquid sprayed from the container. A narrow dip tube, of for example about 1.27mm internal diameter, increases the charge levels on the liquid, and the dip tube material can also be changed to increase charge.

Valve characteristics can be selected which

increase the charge to mass ratio of the liquid product as it is sprayed from the container. A small tailpiece orifice in the housing, of about 0.65mm, increases product charge to mass ratio during spraying. A reduced number of holes in the stem, for example 2 x 0.50mm, also increases product charge during spray. The presence of a vapour phase tap helps to maximise the charge levels, a large orifice vapour phase tap of, for example, about 0.50mm to 1.0mm generally giving higher charge levels.

Changes in the product formulation can also affect charging levels. A formulation containing a mixture of hydrocarbon and water, or an emulsion of an immiscible hydrocarbon and water, will carry a higher charge to mass ratio when sprayed from the aerosol device than either a water alone or hydrocarbon alone formulation.

It is preferred that the microorganism treatment composition for use in the present invention comprises an oil phase, an aqueous phase, a surfactant, an antibacterial or anti-viral agent and a propellant.

Preferably the oil phase includes a  $C_9 - C_{12}$  hydrocarbon which is preferably present in the composition in the amount of from 2 to 10% w/w.

Preferably the surfactant is glyceryl oleate or a polyglycerol oleate, preferably present in the composition in an amount of from 0.1 to 1.0% w/w.

Preferably the propellant is liquified petroleum gas (LPG) which is preferably butane, optionally in admixture with propane. The propellant may be present in an amount of from 10 to 90% w/w depending upon

whether the composition is intended for spraying as a "wet" or as a "dry" composition. For a "wet" composition, the propellant is preferably present in an amount of from 20 to 50% w/w, more preferably in an amount of from 30 to 40% w/w.

The liquid droplets sprayed from the aerosol spray device will generally have diameters in the range of from 5 to 100 micrometres, with a peak of droplets of about 40 micrometres. The liquid which is sprayed from the aerosol spray device may contain a predetermined amount of a particulate material, for example, fumed silica, or a predetermined amount of a volatile solid material, such as menthol or naphthalene.

The method of the present invention, in addition to killing microorganisms, also accelerates the natural process of precipitation of airborne particles by indirect charging of the particles, thereby enabling the air quality to be improved quickly and conveniently.

A can for a typical aerosol spray device is formed of aluminium or lacquered or unlacquered tin plate or the like. The actuator insert may be formed of, for instance, acetal resin. The valve stem lateral opening may typically be in the form of two apertures of diameters 0.51mm.

The present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:-

Figure 1 is a diagrammatic cross section through an aerosol spraying apparatus in accordance with the

invention;

Figure 2 is a diagrammatic cross section through the valve assembly of the apparatus of Figure 1;

Figure 3 is a cross section through the actuator insert of the assembly shown in Figure 2;

Figure 4 shows the configuration of the bore of the spraying head shown in Figure 3 when viewed in the direction A; and

Figure 5 shows the configuration of the swirl chamber of the spraying head shown in Figure 3 when viewed in the direction B.

Referring to Figures 1 and 2, an aerosol spray device in accordance with the invention is shown. It comprises a can 1, formed of aluminium or lacquered or unlacquered tin plate or the like in conventional manner, defining a reservoir 2 for a liquid 3 having a conductivity such that droplets of the liquid can carry an appropriate electrostatic charge. Also located in the can is a gas under pressure which is capable of forcing the liquid 3 out of the can 1 via a conduit system comprising a dip tube 4 and a valve and actuator assembly 5. The dip tube 4 includes one end 6 which terminates at a bottom peripheral part of the can 1 and another end 7 which is connected to a tailpiece 8 of the valve assembly. The tailpiece 8 is secured by a mounting assembly 9 fitted in an opening in the top of the can and includes a lower portion 10 defining a tailpiece orifice 11 to which end 7 of the dip tube 4 is connected. The tailpiece includes a bore 12 of relatively narrow diameter at lower portion 11 and a relatively wider diameter at its upper

portion 13. The valve assembly also includes a stem pipe 14 mounted within the bore 12 of the tailpiece and arranged to be axially displaced within the bore 12 against the action of spring 15. The valve stem 14 includes an internal bore 16 having one or more lateral openings (stem holes) 17 (see Figure 2). The valve assembly includes an actuator 18 having a central bore 19 which accommodates the valve stem 14 such that the bore 16 of the stem pipe 14 is in communication with bore 19 of the actuator. A passage 20 in the actuator extending perpendicularly to the bore 19 links the bore 19 with a recess including a post 21 on which is mounted a spraying head in the form of an insert 22 including a bore 23 which is in communication with the passage 20.

A ring 24 of elastomeric material is provided between the outer surface of the valve stem 14 and, ordinarily, this sealing ring closes the lateral opening 17 in the valve stem 14. The construction of the valve assembly is such that when the actuator 18 is manually depressed, it urges the valve stem 14 downwards against the action of the spring 15 as shown in Figure 2 so that the sealing ring 24 no longer closes the lateral opening 17. In this position, a path is provided from the reservoir 2 to the bore 23 of the spraying head so that liquid can be forced, under the pressure of the gas in the can, to the spraying head via a conduit system comprising the dip tube 4, the tailpiece bore 12, the valve stem bore 16, the actuator bore 19 and the passage 20.

An orifice 27 (not shown in Figure 1) is provided

in the wall of the tailpiece 8 and constitutes a vapour phase tap whereby the gas pressure in the reservoir 2 can act directly on the liquid flowing through the valve assembly. This increases the turbulence of the liquid. It has been found that an increased charge is provided if the diameter of the orifice 27 is at least 0.76mm.

Preferably the lateral opening 17 linking the valve stem bore 16 to the tailpiece bore 12 is in the form of 2 orifices each having a diameter of not more than 0.51mm to enhance electrostatic charge generation. Further, the diameter of the dip tube 4 is preferably as small as possible, for example, 1.2mm, in order to increase the charge imparted to the liquid. Also, charge generation is enhanced if the diameter of the tailpiece orifice 11 is as small as possible eg not more than about 0.64mm.

Referring now to Figure 3, there is shown on an increased scale, a cross section through the actuator insert of the apparatus of Figures 1 and 2. For simplicity, the bore 23 is shown as a single cylindrical aperture in this Figure. However, the bore 23 preferably has the configuration, for instance, shown in Figure 4. The apertures of the bore 23 are denoted by reference numeral 31 and the aperture-defining portions of the bore are denoted by reference numeral 30. The total peripheral length of the aperture-defining portions at the bore outlet is denoted by  $L$  (in mm) and  $a$  is the total area of the aperture at the bore outlet (in  $\text{mm}^2$ ) and the values for  $L$  and  $a$  are as indicated in Figure 4.  $L/a$  exceeds



8 and this condition has been found to be particularly  
conductive to charge development because it signifies,  
an increased contact area between the actuator insert.  
and the liquid passing there through.

5           Many different configurations can be adopted in  
order to produce a high L/a ratio without the cross-  
sectional area a being reduced to a value which would  
allow only low liquid flow rates. Thus, for example  
it is possible to use actuator insert bore configura-  
10       tions (i) wherein the bore outlet comprises a  
plurality of segment-like apertures (with or without a  
central aperture); (ii) wherein the outlet comprises a  
plurality of sector-like apertures; (iii) wherein the  
aperture together form an outlet in the form of a  
15       grill or grid; (iv) wherein the outlet is generally  
cruciform; (v) wherein the apertures together define  
an outlet in the form of concentric rings; and  
combinations of these configurations. Particularly  
preferred are actuator insert bore configurations  
20       wherein a tongue like portion protrudes into the  
liquid flow stream and can be vibrated thereby. This  
vibrational property may cause turbulent flow and  
enhanced electrostatic charge separation of the double  
layer, allowing more charge to move into the bulk of  
25       the liquid.

Referring now to Figure 5, there is shown a plan  
view of one possible configuration of swirl chamber 35  
of the actuator insert 22. The swirl chamber includes  
4 lateral channels 36 equally spaced and tangential to  
30       a central area 37 surrounding the bore 23. In use,  
the liquid driven from the reservoir 2 by the gas

under pressure travels along passage 20 and strikes the channels 36 normal to the longitudinal axis of the channels. The arrangement of the channels is such that the liquid tends to follow a circular motion prior to entering the central area 37 and thence the bore 23. As a consequence, the liquid is subjected to substantial turbulence which enhances the electro-static charge in the liquid.

The following Examples illustrate the invention:-

#### EXAMPLE 1

An aerosol disinfectant composition was prepared from the following components:

	%w/w
Ethanol	54
Silicone surfactant	0.1
Anti-bacterial agent chosen from below	0.8
Water	17.2
Liquified petroleum gas	28

The composition was introduced into a tinplate aerosol can having valve assemblies comprising a 3mm polyethylene dip tube 4, 0.64mm tailpiece orifice 11, 0.64mm vapour phase tap 27 and 4 x 0.61mm valve stem lateral openings 17. The actuator 18 was an Kosmos type fitted with a 0.51/0.66mm Aqua actuator insert 22

(both supplied by Precision Valve).

The anti-bacterial agent may be any suitable material. By way of example, an essential oil may be used, including one or more of the following:

5       Lemon grass, lemon, orange, yeast, clove, thyme, oregano, cinnamaldehyde, cinnamon and/or carvacrol.

A preferred amount of the anti-bacterial agent in the composition is from 0.2 to 0.25% w/w.

10       The charge level on the droplets emitted from this can was artificially raised to a charge to mass ratio of approximately  $-1 \times 10^{-4}$  C/kg by applying a -10 kv charge to the seam of the can from a high voltage power supply.

15       On depression of the actuator 18, a fine spray of liquid droplets having a charge/mass ratio of  $-1 \times 10^{-4}$  C/kg and a flow rate of approximately 1.2 g/sec was obtained. The droplets became rapidly dispersed in the air.

20       The above-described aerosol spray device was compared with a standard, known aerosol spray device loaded with the same aerosol formulation. The following protocol was used.

25       A suspension of micrococcus luteus containing approximately  $10^9$  cfu/ml in water is prepared. HEPA filtered air is supplied to an environmental test chamber with a volume of 28 cubic metres.

30       The bacterial suspension is applied to the test chamber with a nebuliser for 60 seconds and is distributed around the chamber for a further 60 seconds with a re-circulating fan.

A slit-to-agar sampler is activated for 2 hours

obtaining samples after 1, 15, 30, 60 and 120 minutes. The slit-to-agar plates are collected. The plates are assayed, incubated and the colonies counted to provide the control results (which are the average of three experiments).

The above procedure is repeated 3 times, however before activating the slit-to-agar sampler the electrostatically charged test product is sprayed into the test chamber for 10 seconds. This is repeated again 3 times with the conventional non-charged test product.

The results obtained from the charged and non-charged spray products are compared (after taking the control results into account) and it is thereby shown that there is a significant increase in the aerial anti-bacterial performance with the electrostatic product.

## EXAMPLE 2

The test organism *Micrococcus luteus* (ATCC NCTC 2665) obtained from culture was used as a final suspension containing about  $10^9$  cfu/ml in water. The test chamber was of volume  $28\text{m}^3$ , provided with HEPA filtered air supply and extracted air. Equipment in the chamber was remotely controlled from a control room. Bacteria were sprayed from a collision nebulizer for 60 seconds and mixed with the room air for a further 60 seconds by a fan. Five all glass impingers (AGI) were activated at the following times 1, 14, 29, 59 and 119 minutes after bacterial release. Each

impinger collected air from the test chamber for one minute. After the first impinger had finished sampling a test disinfectant spray was released into the chamber from an aerosol can. The test formulation was:-

Component	%w/w
Butane 40	35
Sorbitan Mono-oleate	1
Lemon Grass Oil	7
Sodium Nitrite	0.12
Triethyleneglycol	2.5
Soft Water	54.38

The spray was released for 10 seconds. The performance of an uncharged aerosol composition was compared with the same aerosol composition with charge applied artificially to the can. The voltage applied to the can was -3kV, this achieved an aerosol with a charge-to-mass ratio of  $-1.3 \times 10^{-4}$  C/Kg. The effect of applying charge to the aerosol on the concentration of airborne microorganisms was recorded by the following AGI's. The number of bacteria collected in the AGI was assessed by removing 0.1ml of the liquid from the AGI and placing it on an agar plate, this was replicated once. The plates were then incubated at 30°C for 72 hours. The colonies were counted and the average of the 2 plates presented in the results given below:

- 19 -

**Results**Table 1: Number of *Micrococcus luteus* collected in impinger.

Charge applied to aerosol	AGI 1 1 minute	AGI 2 14 minute	AGI 3 29 minutes	AGI 4 59 minutes	AGI 5 119 minutes
No	3225	70	5	0.8	0.8
Yes	3533	20	0.8	0.8	0.8

**CLAIMS:**

1. A method of disinfecting or sanitising a space occupied by airborne microorganisms and/or viruses, which method comprises directing into the space liquid droplets from a spray device containing a disinfecting or sanitising composition, a unipolar charge being imparted to the said liquid droplets by double layer charging during the spraying of the liquid droplets from the aerosol spray device, the unipolar charge being at a level such that the said droplets have a charge to mass ratio of at least  $\pm 1 \times 10^{-4}$  C/kg.

2. A method as claimed in claim 1 wherein the spray device is an aerosol spray device.

3. A method as claimed in claim 1 or claim 2 wherein the disinfecting or sanitising composition is an emulsion.

4. A method as claimed in any one of the preceding claims wherein the liquid droplets have a diameter in the range of from 5 to 100 micrometres.

5. A method as claimed in any one of the preceding claims wherein the unipolar charge is imparted to the liquid droplets solely by the interaction between the liquid and the spray device, without any charge being imparted thereto from an internal or external charge inducing device.

6. A method as claimed in claim 5 wherein the droplet charge to mass ratio of at least  $\pm 1 \times 10^{-4}$  C/kg is imparted to the droplets as a result of the use of an aerosol spray device with at least one of the features of the material of the actuator, the size and shape of the orifice of the actuator, the diameter of the dip tube, the characteristics of the valve and the formulation of the disinfecting or sanitising composition contained within the aerosol spray device being chosen in order to achieve the said droplet charge to mass ratio by double layer charging imparting the unipolar charge to the droplets during the actual spraying of the liquid droplets from the orifice of the aerosol spray device.

7. A method as claimed in any one of the preceding claims wherein the disinfecting or sanitising composition comprises an oil phase, an aqueous phase, a surfactant, an anti-bacterial agent, a fungicide or an anti-viral agent, and a propellant.

8. A method as claimed in claim 7 wherein the anti-bacterial or anti-viral agent is an essential oil selected from thyme, lemon grass, lemon, orange, grapefruit, yeast, oregano, anise, clove, cinnamaldehyde, cinnamon, carvacrol, rose, lavender, citronella, eucalyptus, peppermint, camphor, sandalwood, juniper berry, Siberian pine needle, pine sylvester, tea tree, litsea, rosewood, patchouli, vetiver, cedarwood and mixtures thereof.



9. A method as claimed in claim 7 wherein the anti-bacterial agent is a quaternary ammonium compound.

5 10. A method according to any one of claims 7 to 9 wherein the oil phase includes a  $C_9 - C_{12}$  hydrocarbon.

10 11. A method as claimed in claim 10 wherein the  $C_9 - C_{12}$  hydrocarbon is present in the composition in an amount of from 2 to 10% w/w.

15 12. A method as claimed in any one of claims 7 to 11 wherein the surfactant is glyceryl oleate or a polyglycerol oleate.

20 13. A method as claimed in any one of claims 7 to 12 wherein the surfactant is present in the composition in an amount of from 0.1 to 1.0% w/w.

14. A method as claimed in any one of claims 7 to 13 wherein the propellant is liquified petroleum gas.

25 15. A method as claimed in claim 14 wherein the propellant is present in the composition in an amount of from 20 to 50% w/w.

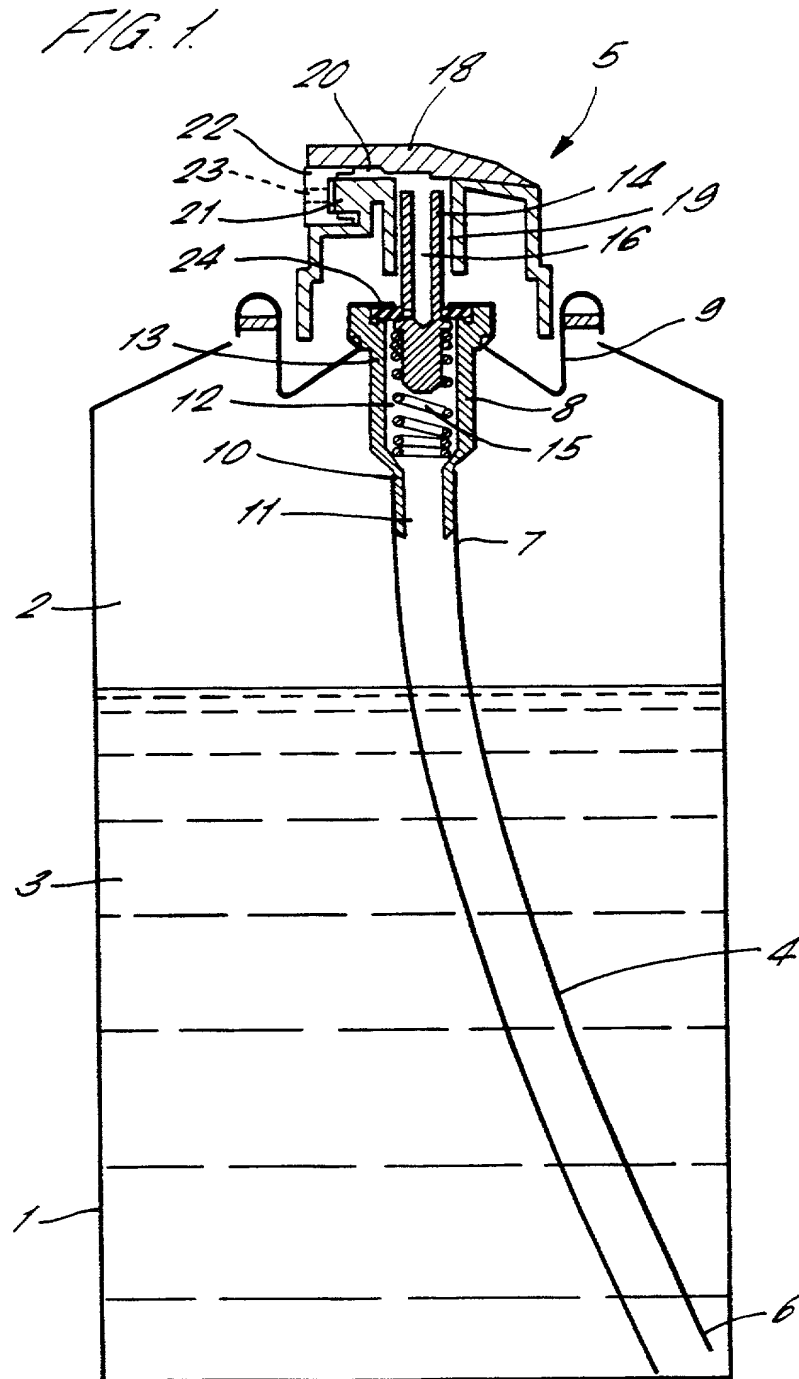


FIG. 2

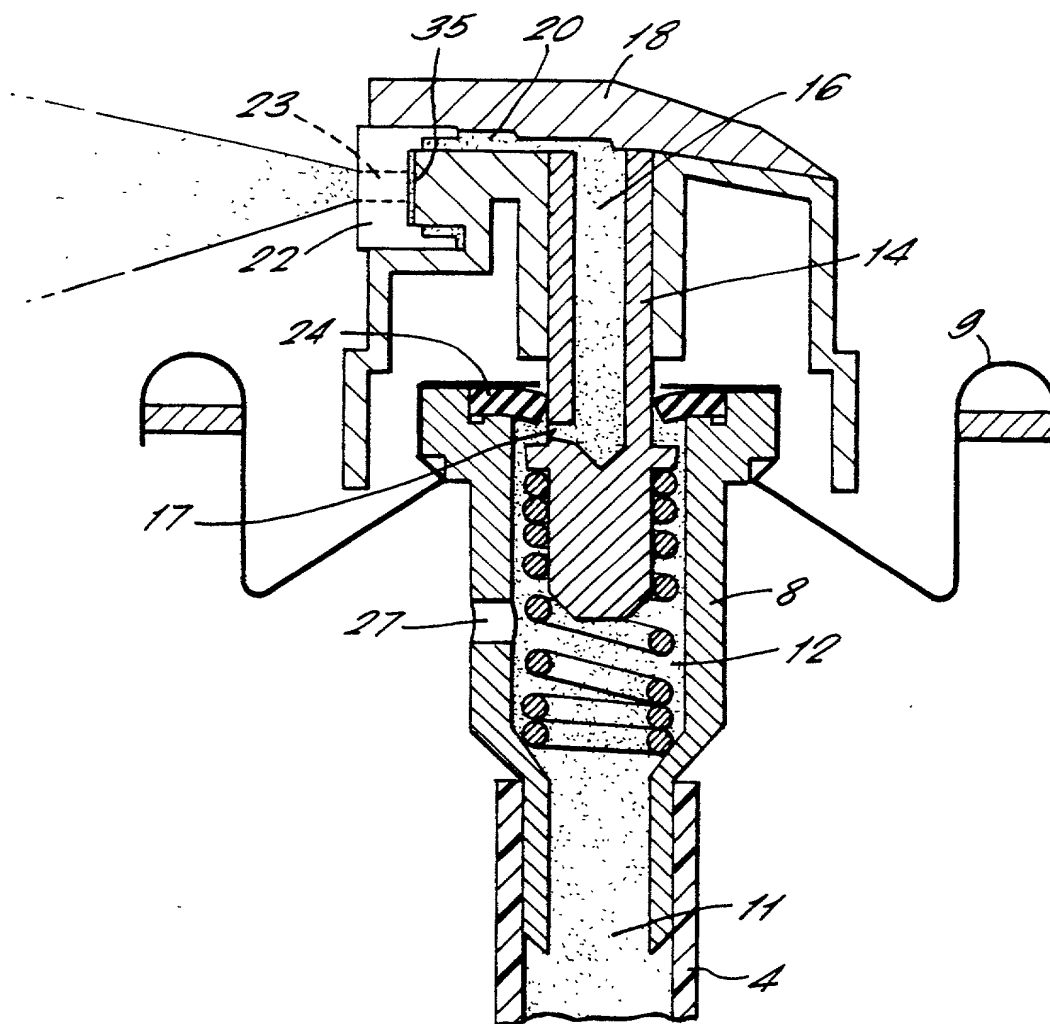


FIG. 3.

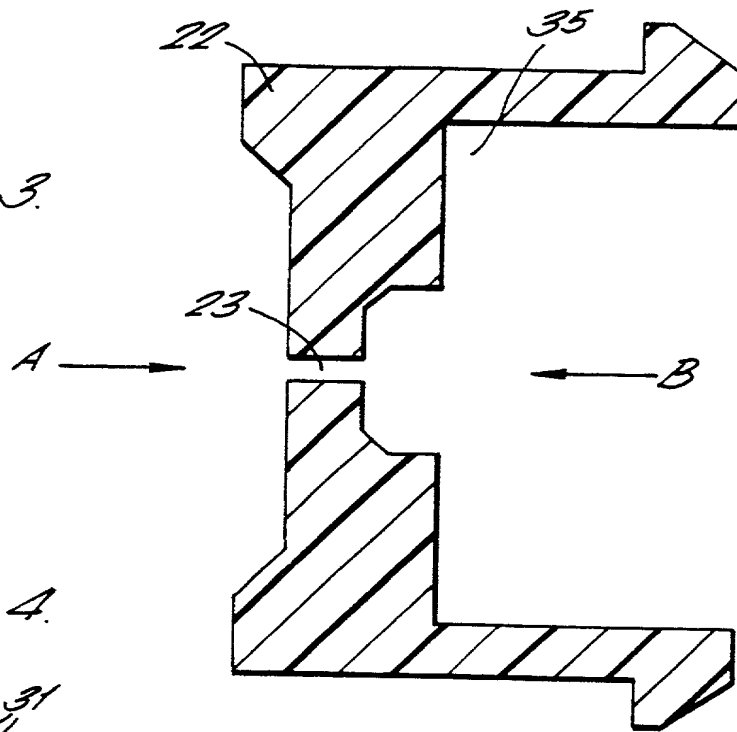
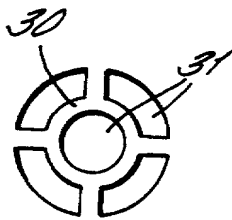
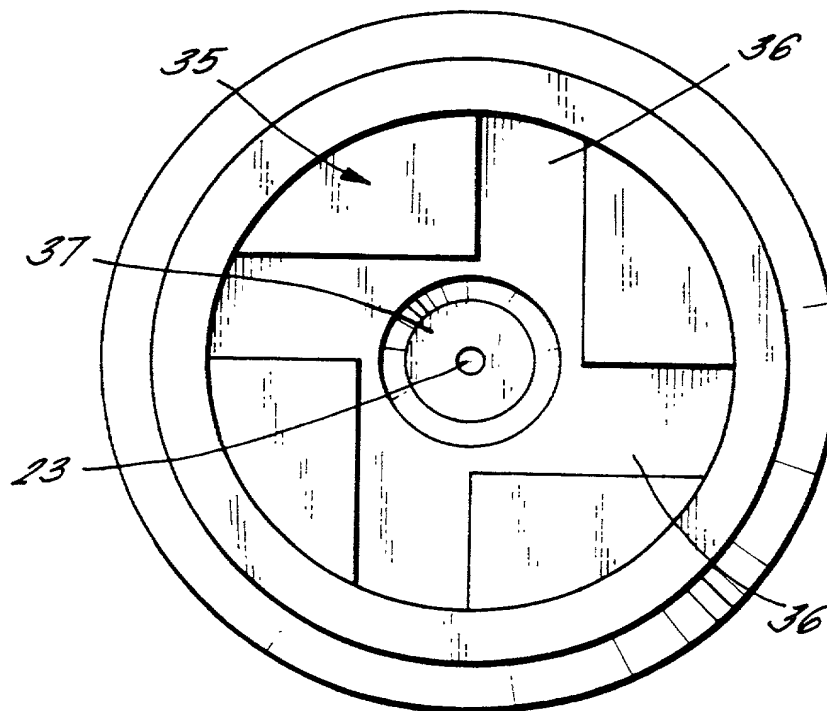


FIG. 4.



$$L = 6.7332$$
$$a = .4992$$

FIG. 5.



## COMBINED DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled TREATMENT OF AIRBORNE MICROORGANISMS, the specification of which:

- ☐ is attached hereto.  
☐ was filed on \_ as Application Serial No. \_ and was amended on \_\_\_\_\_.  
☒ was described and claimed in PCT International Application No. PCT/GB99/01979  
filed on 23 June 1999 and as amended under PCT Article 19 on \_\_\_\_\_.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose all information I know to be material to patentability in accordance with Title 37, Code of Federal Regulations, §1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed:

Country	Application No.	Filing Date	Priority Claimed
United Kingdom	9814377.9	2 July 1998	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No

I hereby appoint the following attorneys and/or agents to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

Frederick H. Rabin, Reg. No. <u>24,488</u>	Andrew N. Parfomak, Reg. No. <u>32,431</u>
John B. Pegram, Reg. No. <u>25,198</u>	William J. Hone, Reg. No. <u>26,739</u>
Richard P. Ferrara, Reg. No. <u>30,632</u>	Stephan J. Filipek, Reg. No. <u>33,384</u>
Samuel Borodach, Reg. No. <u>38,388</u>	Chris T. Mizumoto, Reg. No. <u>42,899</u>
Charles J. Boudreau, Reg. No. <u>42,350</u>	

Address all telephone calls to FREDERICK H. RABIN at telephone number (212) 765-5070.

Address all correspondence to FREDERICK H. RABIN at:

FISH & RICHARDSON P.C.  
45 Rockefeller Plaza, Suite 2800  
New York, NY 10111

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both,

### Combined Declaration and Power of Attorney

Page 2 of 3 Pages

under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patents issued thereon.

10-1  
Full Name of Inventor: RODNEY THOMAS FOX

Inventor's Signature: R.T. Fox

Date: 29/04/01

Residence Address: Cottingham, United Kingdom

Citizenship: Great Britain

Post Office Address: 30 South Street  
Cottingham, Hull HU16 4AS  
United Kingdom GBX

Full Name of Inventor: NEALE HARRISON

10-2  
Inventor's Signature: N.M. Harrison

Date: 6/05/01

Residence Address: Staffordshire, United Kingdom

Citizenship: Great Britain

Post Office Address: 27 Cromwell Close  
Tutbury, Burton on Trent  
Staffordshire DE13 9HZ  
United Kingdom GBX

Full Name of Inventor: JOHN FARRELL HUGHES

10-3  
Inventor's Signature: John Farrell Hughes

Date: 19/01/2001

Residence Address: Southampton, United Kingdom

Citizenship: Great Britain

Post Office Address: 2 Shepherd's Close  
Bartley  
Southampton SO40 2JL  
United Kingdom GBX

4-00  
Full Name of Inventor: DUNCAN ROGER HARPER

Inventor's Signature: DR Harper

Date: 24/04/01

Residence Address: Hull, United Kingdom GBX

Citizenship: Great Britain

Post Office Address: Flat 2  
78 The Boulevard  
Hull HU3 2TA  
UNITED KINGDOM

Combined Declaration and Power of Attorney

Page 3 of 3 Pages

5-00 Full Name of  
Inventor: LINDSEY FAYE WHITMORE

Inventor's Signature: Lindsey Faye Whitmore Date: 19/01/2001  
Residence Address: Winchester, United Kingdom  
Citizenship: Great Britain  
Post Office Address: 60 Tees Farm Road  
Colden Common  
Winchester SO21 1UQ  
United Kingdom GBX

6-00 Full Name of  
Inventor: KAREN LOUISE <sup>KJ</sup> FERRIM

Inventor's Signature: Karen Louise Ferrim Date: 19/01/2001  
Residence Address: Southampton, United Kingdom  
Citizenship: Great Britain  
Post Office Address: 22 Pilgrim Place  
Mansbridge  
Southampton SO18 2LG  
UNITED KINGDOM GBX

2-00 Full Name of  
Inventor: JENNIFER JANE KNAPP

Inventor's Signature: Jennifer Jane Knapp Date: 24/01/2001  
Residence Address: Southampton, United Kingdom  
Citizenship: U.S.A.  
Post Office Address: 23 Spring Crescent  
Southampton SO17 2FZ  
UNITED KINGDOM GBX